

## ABSTRACT OF THE DISCLOSURE

**[0045]** An integrated photoacoustic spectroscopy (PAS) cell is fabricated using microelectromechanical (MEMS) techniques. The multi-layer structure includes an inner layer with a patterned resonant cavity disposed between top and bottom outer layers and a microphone acoustically coupled to the resonant cavity. In the preferred embodiment, the microphone is a piezoelectric thin-film membrane formed on one of the outer layers. The inner layer is additionally patterned to include buffer cavities on either side of the resonant cavity, and one or both of the top and bottom outer layers are also patterned to include buffer cavities aligned with the buffer cavities in the inner layer on either side of the resonant cavity. The preferred fabrication method involves joining an inner silicon substrate to a pair of outer silicon substrates, thereby encapsulating the resonant cavity, and depositing a piezoelectric thin film onto one of the outer substrates which is then patterned to create an acoustic sensor.